Physics Department Minor Incidents Log

Incident No.	2003-01	Date:	2/5/03
Reportable	No		
Status	Final Committee Report		
Groups Involved:	ATF		
Lead Investigator:	Ilan Ben-Zvi, Group Leader		

Description:
On Friday morning, ATF's Antonio Rodrigues noticed a minor oil spill on the floor of the ATF room C1 near the CO2 laser amplifier. The spill (total estimated volume 100-200 cc) resulted of dripping from under the top lid of the oil-filled tank attached to the amplifier. This tank contains a Pulse-Forming Network (PFN) – voltage generator for x-ray gun used for ionization of the amplifier high-pressure gas volume. Closer inspection revealed that this dripping is a result of a small tilt of the PFN tank and bending deformation of its sidewall. Two of three tubes supporting the preionizer assembly which penetrate the Laser Amplifier pressure vessel wall moved in their sealing gland. The movement resulted in the sidewall of the connected electronics box to be indented. The dent displaced the dielectric oil within the container causing a small spill. The now misaligned preionizer effectively rendered the Laser Amplifier inoperable. No amplifier gas was released.
There was a small oil spill. However, this being a mineral oil, so no hazard to health or environment was generated.
The side of the electronics box was deformed. One tube of the preionizer was scratched on its external surface. The interior surface of one of the penetrating seal glands on the amplifier pressure vessel had burrs. The o-ring seals were rendered unusable.
An examination of the parts and drawings seem to indicate there was a design change in the method of restraining the preionizer relative to the amplifier pressure vessel. The original design appears to rely on welded bosses on the preionizer vessel intended to press against the ID of the wall of the amplifier pressure-vessel to carry the pressure-induced load from the penetrating tubes. This load is significant: ~3250 lbs for each of the two 6 inch diameter penetrating tubes and an additional ~360 lbs for the 2 inch diameter tube.
The existing configuration preionizer chamber had been moved by the manufacturer inward, perhaps to adjust the spark gap, so that the "bosses" were no longer in contact with the pressure vessel wall. The force tending to push the tubes out of the vessel was counteracted by friction of the compressed O-ring in the sealing gland.
This gland is designed like a "stuffing box" or "packing gland" seal where mechanically applied pressure to the sealing material is used to maintain a tight seal on a rotating or reciprocating shaft. Normally the seal material would not be an o-ring, but some packing material with a generally rectangular cross section designed for the application.
A gland of this design is not use to retain a shaft or tube by friction. Rather a separate mechanical means is used to contain the pressure forces.

Root Cause: **Inadequate or Defective Design**
Lack of engineering review of change introduced by the manufacturer. Manufacturer representative changed the position of the x-ray tube but did not anticipate the possibility of the slippage of the preionizer.

Contributing Causes:
None.

Corrective Actions: ATF Group
Upon discovery of the oil spill:
1. The amplifier pressure has been vented
2. The AC power supply box red tagged
3. The oil dumped from the PFN box
4. Oil spill wiped from the floor

Further action to access the damage and develop corrective measures:

5. PFN tank is disconnected from the feed through and removed from the support stand
6. Internal electrical components are removed from the PFN tank
7. Amplifier high-pressure vessel is opened to gain access to the gun
8. Gun is disconnected form the vacuum system and removed from the pressure vessel

Assessment of the damage

9. Minor residual bent in the side wall of the PFN tank
10. Plastic deformation and wearing of rubber o-rings (6 years old) that seal the gun feedthroughs
11. Minor scratch on the vacuum feed-through sealing surface

Repair and reassembling

12. The bent wall of the PFN tank is flattened with a jack
13. Fresh o-rings will be installed
14. Scratch will be repaired with a sand paper
15. Assembling of components in the reverse sequence according to items 1-8
16. Leak test
17. Specially designed clamps attached between the external flanges of the pressure vessel and the gun will hold the gun in the desired position preventing it from moving.

The corrective action #17 is the only modification to the amplifier and is sufficient to prevent the similar malfunction.

Corrective Actions: Department

1. Require stress calculations for clamps (item #17 above) to be reviewed by Department Engineer.
2. Group Safety Coordinators (GSC) will be informed and there will be discussion of this incident at the next GSC meeting, Group Leaders will be briefed, and the Department will be informed of the incident at the next Department Meeting.

Lessons Learned:

Engineering review of any modification to equipment design even when performed by the original manufacturer is required prior to implementation.

The above incident has been investigated and requires no further action.

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S. Aronson, Department Chair Date

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S. M. Shapiro, ES&H Committee Chair Date